STAEDTLER MARS GmbH & Co. KG
Nuremberg

Mechanical pencils

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1 Mechanical pencils

Refillable pencils according to DIN ISO 9177

Definition

A refillable pencil is defined as being a lead-holding manual drawing instrument with lead-feed mechanism for drawing and/or writing use.

1.1 History

History of the STAEDTLER mechanical pencil lead

As early as the beginning of the 19th century, there were already pencils on the market that weren't encased in wood. They had a twist mechanism for advancing the graphite lead forwards to the writing tip. Up until the first world war, it was standard practice for these early mechanical pencils to hold a single piece of lead with a 2mm diameter.

The mechanical pencil lead – also known as fineline lead – is a relatively new invention which originates from traditional pencil lead. Wood-cased pencils have the disadvantage, that they need sharpening. So the idea was to develop a lead that was so thin, it wouldn't have to be sharpened at all.

The first generation of fineline leads, was based on common pencil lead. These leads were made out of a mixture of graphite and clay, i.e. so-called ceramic leads. They were clamped in holders by means of a clamping chuck.

Leads with small diameters of 0.5, 0.7 and 0.9 mm were neither very resistant to breakage, nor were they particularly pliable.

Customers were not at all satisfied with the performance of these leads and the search for new materials began.

While working on the development of STAEDTLER mechanical pencil leads, chemists discovered that carbon fibre had a number of advantages to offer – it is very light in weight at the same time as being extremely resilient and pliable. Carbon fibre is primarily used as a reinforcing material in the aeronautic industry.

Back in 1880, Edison was the first man to succeed in coking strands of cellulose and he developed carbon filaments out of them for his electric light bulb invention. Just as was the case with the first mechanical pencil leads almost 100 years later, this early carbon fibre was neither particularly stable, nor was it very flexible.

In 1959, first publications began to appear in specialist journals on flexible carbon fibres. In 1961, Shindo provided the scientific background on the carbonisation process - i.e. the transformation of high polymer, organic substances such as cellulose into carbon – and it is on these findings that the manufacture of the Mars micro carbon lead is based (see 1.3.1).

The Mars micro carbon lead (formerly Marsmicro Polycarbon) was launched onto the market in 1976.

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1.2 Leadholders

These are also known as e.g. refill drawing pencils, drop pencils, chuck pencils. They are used for drawing, sketching and writing. The 2mm lead is the same as the lead used in wood-cased pencils.

Example

Illustration 1: Mars technico 780 C

1.2.1 Lead

Lead composition

Graphite	for the blackness
Clay	for the hardness
Wax	for the smoothness

The degree is indicated on the lead.

1.2.2 Holder

Leadholder barrels are made out of a synthetic material (e.g. polystyrene PS). All exterior metal parts are nickel-plated.

A lead pointer is integrated in the push-button of the Mars technico.

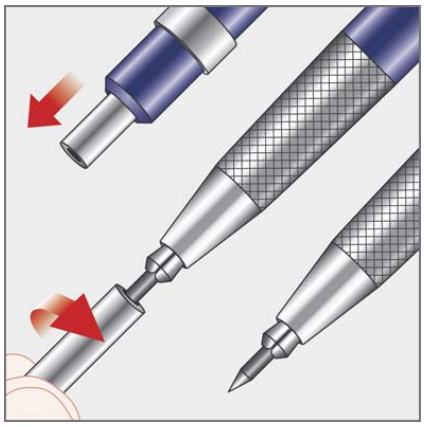

Illustration 2: Mars technico

Instructions for use

Simply remove the Mars technico's push-button, insert the lead into the metal opening and sharpen (see illustration).

We recommend the lead pointer 502 for sharpening 2mm leads.
It comes equipped with both a pointed cone (ideal for technical drawing use) and a normal cone (for general writing purposes).

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1.2.3 Function

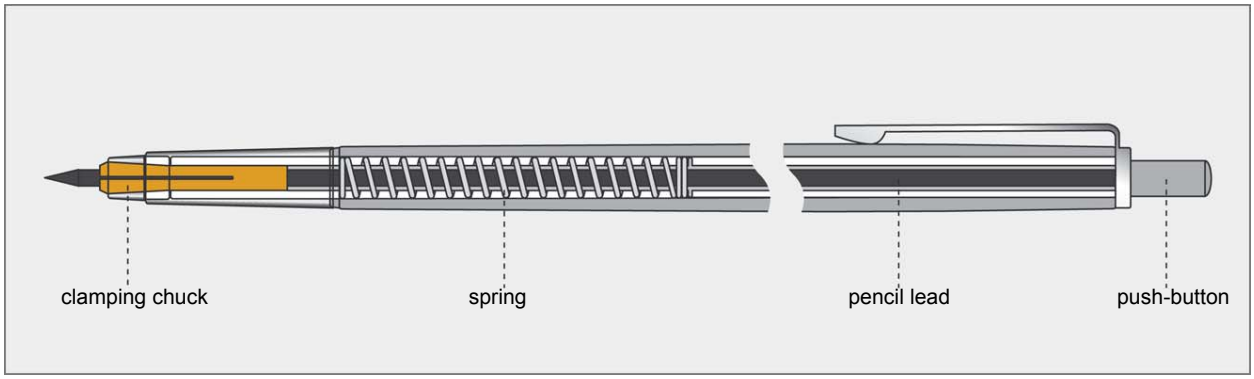

Illustration 3: Longitudinal section of a leadholder

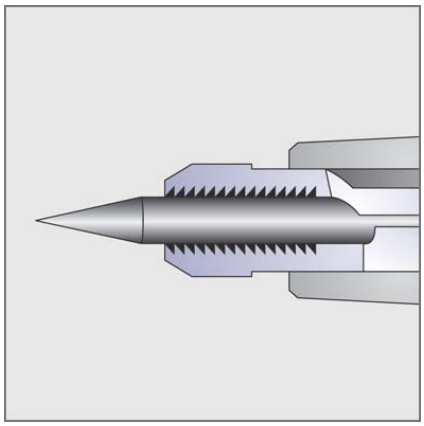

Illustration 4: Clamping chuck

The clamping chuck is opened when the push-button is pressed. The lead's own weight causes it to drop down.

Once the lead has reached the required position, the push-button is released.

The powerful clamping chuck firmly holds the lead, eliminating any unwanted movement.

The clamping chuck is grooved on the inside to prevent the lead from rotating during pointing.

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1.3 Mechanical pencils

Mechanical pencils, also known as fineline pencils, are, depending on the model, suitable for writing and drawing. Mechanical pencil leads are available in the diameters 0.3 – 0.9 mm.

Examples

Illustration 5: Mechanical pencil for drawing and writing: Mars micro 775

Illustration 6: Mechanical pencil for writing: graphite 779

Differences

The mechanical pencil Mars micro 775 has a fixed, cylindrical lead sleeve, making it especially suitable for use with rulers and templates.

The mechanical pencil graphite 779 on the other hand comes equipped with a slightly cushioned, tapered lead sleeve, making it ideal for writing purposes. With this model, as soon as the lead protrusion is exhausted, the lead sleeve automatically retracts when writing is continued in line with the amount of used up lead, without the user having to manually forward the lead via the push-button.

1.3.1 Mars micro carbon lead

Note

STAEDTLER mechanical pencil leads are made out of natural and nature-identical substances and offer excellent product characteristics.

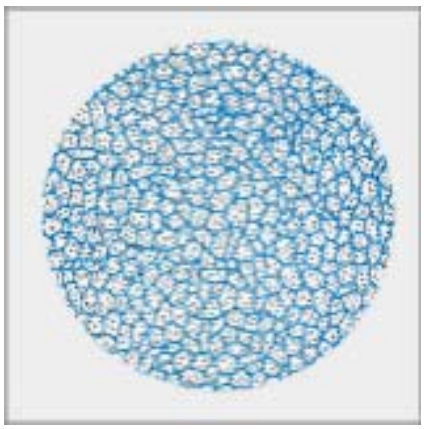

Illustration 7:
Cross section of a mechanical pencil lead

Instead of clay, the lead contains a macromolecular, i.e. high polymer, organic substance on the basis of a natural material (e.g. cellulose).

This is mixed with a particularly pure, very fine-grained graphite. The higher the quality of the graphite used, the smoother the lead.

During the firing of the lead in an oxygen-free atmosphere (carbonisation), the cellulose gets transformed into carbon.
The resulting non-ceramic bonding is very resilient and elastic.

The gentle firing process ensures that the structure is homogenous and that the leads are blister-free and highly resistant to breakage.

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1.3.2 Holder

The mechanical pencil barrels are made out of a synthetic material (e.g. polypropylene PP, acrylic butadiene-styrene ABS, polyoxymethylene POM).

All exterior metal parts are either nickel-plated or chrome-plated.

1.3.3 Mechanical pencil components

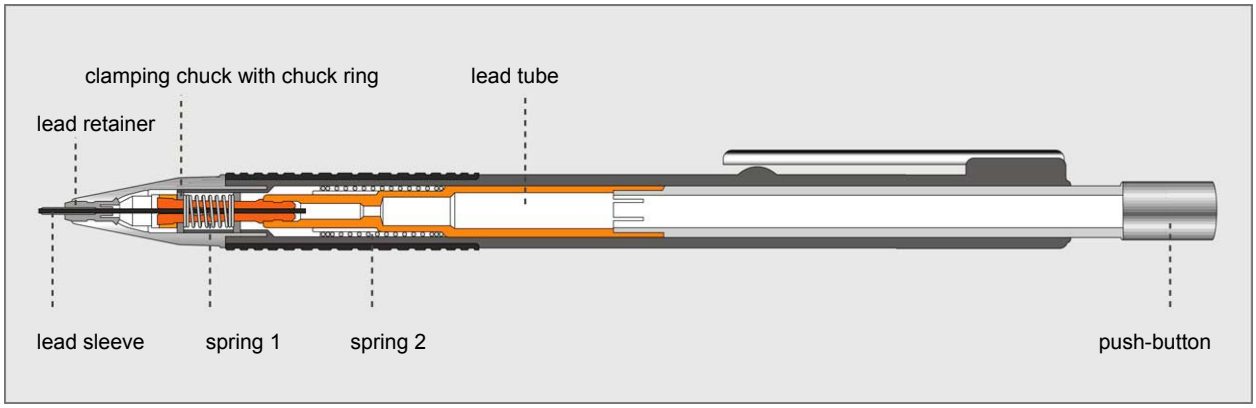

Illustration 8: Longitudinal section of the mechanical pencil Mars micro 775

1. The lead sleeve protects the lead from breakage and facilitates precision work with rulers and templates.
2. The lead retainer holds the lead in position when the chuck is released, so that it does not fall out.
3. The clamping chuck and chuck ring form the lead's transport unit. The chuck always advances the lead an equal amount of distance out of the lead sleeve (see "function").
4. The lead tube can hold up to 12 refill leads.
5. Springs

   spring 1 supports the mechanics
   spring 2 cushions the lead

Tip

We recommend the use of Mars micro carbon mechanical pencil leads which have been subject to strict diameter controls.

Lead feed function: see next page

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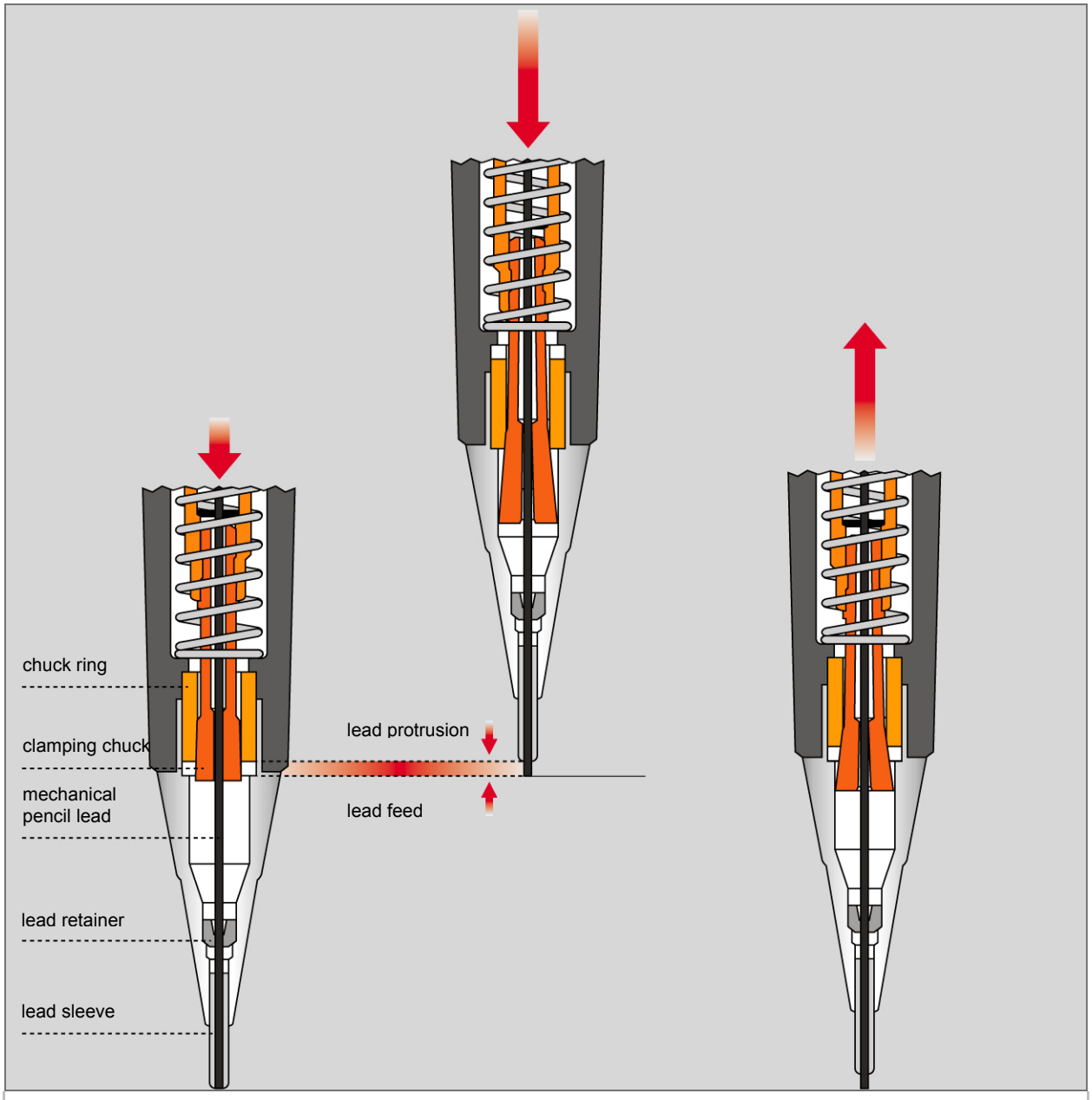
1.3.4 Function



Used-up lead

- Pencil in writing position with used-up mechanical pencil lead

Lead feed

- Lead is transported forwards
- Chuck ring is as far back as it will go
- Clamping chuck is released
- Lead retainer now holds the lead

Lead clamp

- Lead is held by lead retainer
- Open clamping chuck pushes chuck ring back as far as it will go
- Clamping chuck retracts back inside chuck ring and firmly clamps the lead in place again
- The firmly closed chuck now prevents the lead from slipping backwards

Illustration 9: Function of the Mars micro mechanical pencil mechanics

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1.4 Instructions for use for mechanical pencil 775

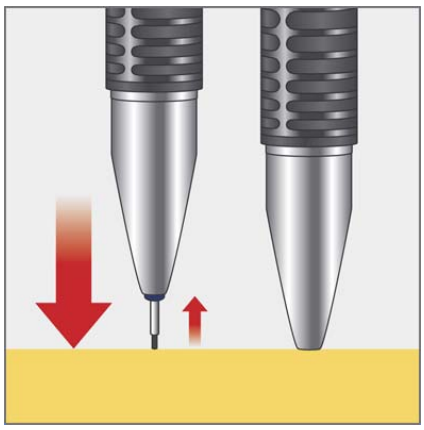

Illustration 10: Pocket-safe thanks to retractable lead sleeve

Pocket-safe thanks to retractable lead sleeve

Stand the pencil with the tip pointing downwards on a surface.
Press the push-button and, at the same time, push the barrel downwards towards the surface, exerting a slight pressure whilst you do so.

Tip

Avoid applying too much pressure as this may cause damage to the lead sleeve.

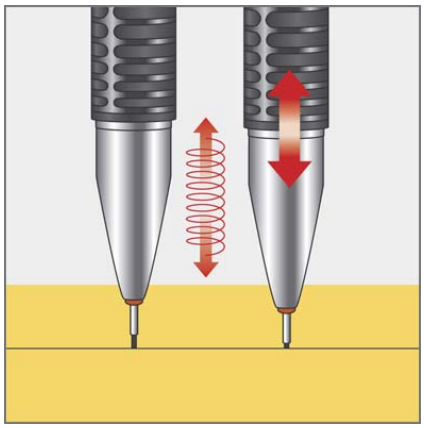

Illustration 11: Cushioned lead

Cushioned lead

The mechanical pencil lead is cushioned, protecting it from breakage.

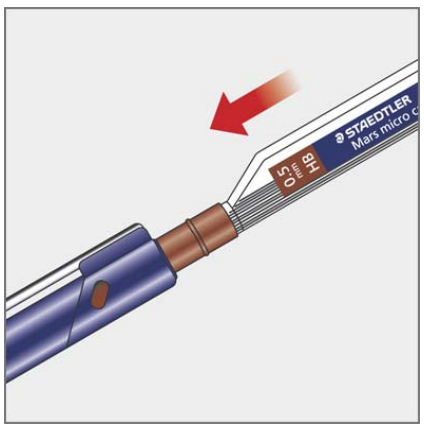

Illustration 12: Easy to refill

Refilling with mechanical pencil leads

Simply insert the neck of the refill lead tube into the end of the mechanical pencil.
The entire content (12 leads) can be filled into the mechanical pencils Mars micro 775 and micro 779 in one go.

Note

In the case of line width ...09, fewer leads should be refilled due to the large diameter of the leads.

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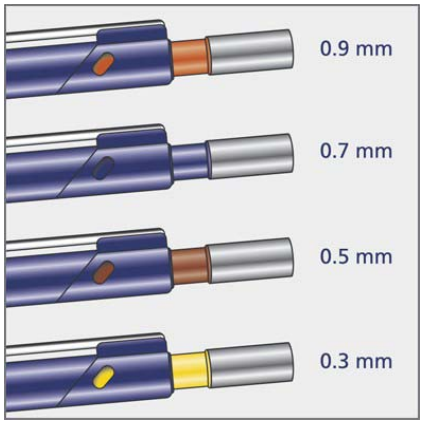

Illustration 13: ISO colour coding

Colour coding for line width indication

The identical colour coding of mechanical pencils, mechanical pencil leads and technical pens facilitates recognition of the different line widths.

STAEDTLER quality control: see next page

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1.5 Quality control

The reliability of a mechanical pencil is very much dependent on the quality of the mechanical pencil leads. Even slight irregularities in the lead structure may lead to a reduction in the lead's tensile strength. Deviations in the exterior of the lead can have a negative effect on the lead feed.

Inspection of the STAEDTLER mechanical pencil leads takes place at three key stages of the production process:

- Incoming control: Inspection of the purity of the raw materials
- Production control: Visual inspection for preventing deformations, thickening or blistering
- Final control: Inspection conforming to ISO 9177/3

The ISO standard defines the acceptable tolerances for the break-resistance and dimension of the leads.
Mechanical pencil lead must be pliable yet, at the same time, offer a high level of break resistance.

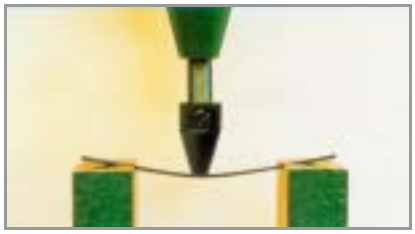

Illustration 14: Measuring the lead elasticity

Measuring the lead elasticity

Illustration 15: Measuring the tensile strength

Measuring the tensile strength of the lead point in writing position

Note

Special features relating to certain models:

775 / 779	with cushioned lead
775 / 779 / 772 / 773	with fully retractable lead sleeve

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